Before the
Federal Communications Commission
Washington, D.C. 20554

In the Matter of	)	
	)	
Advanced Television Systems	)	
and Their Impact Upon the	)	MM Docket No. 87-268
Existing Television Broadcast	)	
Service	)	

TO: The Commission

BROADCASTERS' COMMENTS ON THE FIFTH
NOTICE OF PROPOSED RULEMAKING

July 11, 1996

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SUMMARY

There is theory and there is reality. In real life, investment decisions have to be made. Broadcasters must decide whether to invest billions of dollars in new equipment without new revenue streams to cover capital costs and without assurance that their audiences will follow. Investors need a reasonable expectation that there will be a critical mass of viewers before they will commit their dollars. Manufacturers need certainty before they can begin producing advanced television receivers. There is no room for fits and starts. Absent a standard, investment and manufacturing decisions could be stalled, thwarting the ability to convert rapidly and smoothly to digital broadcasting. . . . Most importantly, consumers need certainty. They need to know that the television set they buy in Louisville will work when they move to Lincoln or Little Rock or Lubbock. They need to be assured that their new set will continue to work for years into the future. The adoption of a single standard would result in the manufacture and purchase of a large volume of digital television receivers, leading to lower costs and a rapid decrease in prices.

-- *Separate Statement of Commissioner Susan Ness in the above captioned proceeding*

In 1987, the Commission started down the road toward the adoption of a transmission standard for advanced digital television ("DTV") by empaneling the Advisory Committee on Advanced Television Service ("ACATS") to oversee private industry development of terrestrial DTV technologies. The Commission's pace picked up in 1990, when it announced its intention to select a transmission standard from among competing transmission systems then undergoing testing. We are now at the end of that road. Another one lies ahead -- it is the digital thoroughfare that free, over-the-air broadcasting can bring to every American's home. This will only happen if the Commission completes the journey it began nine years ago by adopting the single transmission standard necessary to foster the industry and consumer investment required by the roll-out of DTV.

All agree that it will be an enormously complex task to replace the public's fifty-year-old television service, including its more than 1600 stations and 200

million sets. Nothing like this task has ever been undertaken and no one knows exactly how it will unfold. Previous, far less complex transitions to improved broadcast technologies (e.g., AM stereo) teach that, to make it work, the Commission must adopt a transmission standard. The Advanced Television Systems Committee Digital Television Standard ("ATSC DTV Standard") that is proposed for adoption is universally acknowledged as exceptional. Economists recognize the value of standards. That value is strikingly evident in the ACATS process that galvanized the broadcasting, cable, equipment manufacturing, computer, motion picture and other affected industries into reaching a consensus on the standard that is now before the Commission. That standard suits a wide range of functions today and can extend to accommodate innovations tomorrow. The ATSC DTV Standard was designed specifically to be hospitable to innovation, distinguishing it from many other standards of the past. The NTSC standard that broadcast television now has outgrown was a crucial building block for the nation's television service and was able to stretch to accommodate color, stereo and other improvements. The ATSC DTV Standard is far more flexible than the NTSC standard in this regard and will accommodate far more growth and change in the years to come.

Governmental adoption of standards may not be necessary for new technologies that can be introduced gradually, tested in the market, and then reintroduced with plenty of room for trial and error. But DTV does not fall into this category. There are no second chances for the nation's system of free over-the-air broadcasting, where what is proposed is not the introduction of a new technology but the enormously complex upgrading of an existing service that cannot brook interruption or uncertainty. The public has a special stake in the expeditious improvement of the

universally available free broadcasting service that is simply not present in most other situations where the government's standard-setting role is at issue. Voluntary adherence to a single DTV standard or adoption of just parts of such a standard likely would create enough uncertainty and haphazard experimentation to scuttle the transition to DTV. The ATSC DTV Standard has emerged from nine years of experimentation under the supervision of the government-industry advisory committee. Its universally recognized excellence makes adoption of a single standard a no-lose proposition, whereas not adopting the ATSC DTV Standard in its entirety would risk the public's free television service.

But simply mandating a standard for broadcast television will not be enough, given that more than 60% of the public gets at least some of its television service from cable and a growing percentage subscribes to other video delivery systems. An incompatible cable technology would require consumers to purchase unduly expensive sets with multiple decoders or set-top boxes, thereby frustrating consumers' access to broadcast DTV and enhancing cable's gate-keeping function. In addition, broadcast television would lose its ability to compete fairly with other delivery mechanisms. There is no reason for this to happen. The ATSC DTV Standard is friendly to cable and other video delivery systems. The Commission should take all steps necessary to ensure that the cable industry adopts the ATSC DTV Standard, or achieves maximum commonality with it, in order to deliver to the consumer the benefits that the DTV Standard affords -- access to DTV and less expensive and more versatile television sets. This is what the public expects.

By the same token, the Commission should adopt such receiver standards as are necessary to ensure that consumers are able to choose from equipment that

matches at the receiving end the performance levels that the ATSC DTV Standard promises at the transmitting end. These standards should assure consumers that the sets they buy will be capable of rejecting interference and receiving all formats included in the ATSC DTV Standard.

Once these steps are taken, the Commission can move forward with the intricate assignment of DTV channels with the assurance that at least the signal delivery component of the puzzle is in place and is right.

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These comments on the Commission's Fifth Further Notice of Proposed Rule Making (FCC 96-207, released May 20, 1996) ("Fifth NPRM" or "Notice") are submitted on behalf of parties representing a cross-section of the country's terrestrial broadcast television stations and networks ("Broadcasters").[1/] We applaud the Commission for its consideration of how and why a transmission standard was developed for advanced digital television ("DTV"), with the full participation of interested industries and under the guidance of the Commission's Advisory Committee on Advanced Television Service ("ACATS"). We also support the Notice's proposal to adopt the Advanced Television Systems Committee ("ATSC")[2/] DTV transmission

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[1/] For ease of reference, these comments refer to signatories as "Broadcasters," as have previous filings in this proceeding, even though the signatories to all these filings may not identical.

[2/] The ATSC was established in 1982 by the Electronic Industries Association, the Institute for Electrical and Electronic Engineers, the National Association of Broadcasters, the National Cable Television Association and the Society of Motion Picture and Television Engineers. It now consists of more than 50 companies with an interest in advanced television. It is engaged in developing and coordinating voluntary industry standards for DTV in the U.S. and in international arenas. In early 1995, the ATSC completed its work to document a broadcast DTV transmission system based on the Grand Alliance system. The resulting standard, as revised, was

standard (the "ATSC DTV Standard" or "DTV Standard") in its entirety, as ACATS recommended.[3/]

The reasons for adoption of the DTV Standard begin with its exceptional quality and flexibility. But beyond the merits of the DTV Standard itself and the fairness of the process that formed it, lie simple economic realities. Prompt adoption of the DTV Standard is necessary to ensure that consumers can purchase affordable and long-lived DTV receivers and that DTV has a chance to compete in the marketplace. Additional measures to bolster consumer confidence that the sets they buy will be compatible with cable and other video transmission technologies also may be necessary. Only by taking these first steps can the Commission hope to achieve its goal of "fostering an expeditious and orderly transition to digital technology that will allow the public to receive the benefits of digital television . . .[and] ensuring that the spectrum . . .will be used in a manner that best serves the public interest."[4/]

These comments return to the basic principle we espoused in response to the Fourth NPRM. That principle is that, while free marketplace forces will be critical to the ultimate success and shape of DTV, Commission involvement is necessary to guide DTV implementation in three respects: 1) mandating a DTV transmission standard (so as to facilitate efficient market transactions), (2) ensuring compatibility with other media (so as to foster competition), and (3) assigning DTV channels (so as to safeguard

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approved overwhelmingly by letter ballot closing September 15, 1995.

[3/] ACATS recommended adoption of the ATSC DTV Standard in its Advisory Committee Final Report and Recommendation, Federal Communications Commission Advisory Committee on Advanced Television Service, November 28, 1995 ("ACATS Report").

[4/] Fourth Notice of Proposed Rulemaking and Third Further Notice of Inquiry, MM Docket No. 87-268 (August 9, 1995), at 4 ("Fourth NPRM").

the technical viability of DTV). Congressional leaders took a similar view of appropriate Commission involvement in their letter of June 19 to Chairman Hundt urging the expeditious conclusion of this proceeding, including the promulgation of a standard and the adoption of a table of allotments and assignments.[5/]

I. THE ATSC DTV STANDARD ACHIEVES THE FLEXIBILITY AND TECHNICAL EXCELLENCE NECESSARY TO SUPPORT INTEROPERABLE, DYNAMIC, SPECTRUM SAVING AND FREE DTV.

The Notice proposes adoption of each element of the ATSC DTV Standard. See Fifth NPRM, at 37. In making this proposal, the Notice recognizes the integrity of the nine-year process that led to the DTV Standard -- a process involving over one thousand individuals, including representatives of the broadcasting, program producing, equipment manufacturing, academic, motion picture and computer communities as well as Commission personnel. See id., at 3. It also recognizes the virtues of the DTV Standard itself -- a protocol for "a remarkable system that is capable and flexible well beyond the expectations of a few short years ago. It is the product of the genius and persistence of its creators and is a tribute to their efforts." See id., at 18.

A. THE DTV STANDARD WAS DEVELOPED THROUGH A UNIQUELY OPEN AND INCLUSIVE PROCESS.

The genius of the ATSC DTV Standard results in part from the fact that the "DTV Standard was arrived at only after years of thoughtful consideration and expert research and development in an open process in which all interests were able to participate." See Fifth NPRM, at 20. Progress toward a national advanced television standard began in 1987 with the Reagan Administration's realization that the

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[5/] See Letter of Representatives Gingrich, Bliley, and Dingell and Senators Lott and Hollings to Chairman Hundt (June 19, 1996).

development of an advanced television technology and standard would enable American industry to gain and exploit technical excellence in this area. The Commission responded by establishing ACATS to evaluate candidate transmission systems and recommend a national standard. Commission leadership continued under three successive FCC chairmen. working through and in tandem with the ACATS process which established an open competition in which 23 digital and analog systems competed for ACATS recognition. Broadcasters (later joined by the Electronic Industries Association and with substantial support from the cable industry) contributed a scientific forum for this competition by establishing the Advanced Television Test Center ("ATTC") in 1988 to test the competing prototype equipment.

The constraints of the existing television broadcast spectrum allocation, the need to accommodate double the number of channels therein without undue interference to the public's existing NTSC service, and the intensive data requirements of high definition television ("HDTV") strongly favored digital systems that could take advantage of digital compression technology.[6/] In 1991 and 1992, the ATTC tested two analog and four digital advanced television systems. In mid-1993, pursuant to an ACATS recommendation, the competing digital systems joined in a "Grand Alliance" to create the optimal DTV system.[7/] Testing of this system according to ACATS test plans proceeded at the ATTC through 1994 and part of 1995. In November 1995,

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[6/] HDTV requires the transmission of five times as much information in a television channel as does current NTSC service

[7/] The members of the Grand Alliance are AT&T, David Sarnoff Research Center, General Instrument Corporation, Massachusetts Institute of Technology, Philips Electronics North America Corporation, Thomson Consumer Electronics, and Zenith Electronics Corporation.

ACATS delivered its final report to the FCC recommending adoption of the DTV Standard based on the Grand Alliance system.

Throughout this process, the design and execution of the testing were open to all interested parties. ACATS held public meetings to establish test plans and review test results. Its voting membership on the date that it recommended the DTV Standard to the Commission consisted of 24 companies, including the Digital Equipment Corporation and Microsoft. ATTC provided access and information to government and industry representatives from the U.S. and abroad to maximize the transparency of the process, consistent with preserving the trade secrets of the various proponents whose systems were being tested. CableLabs, the cable industry's research organization, shared ATTC lab and office space and attended ATTC Board meetings. The ATSC members responsible for documenting the DTV Standard, embodied the entire range of interests that DTV affects.[8/] In addition to broadcasters and equipment manufacturers, they include such companies as AT&T, the Eastman Kodak Company, Home Box Office, Sony Pictures Entertainment, and Universal City Studios.

The participation of the computer and other industries in the ACATS and ATSC processes was key to the development of a standard flexible and capacious enough to accommodate the diverse interests of broadcasters, cable companies, equipment manufacturers, film and television producers, and computer hardware and software companies, all for the benefit of the consumer. That the ATSC process achieved so much success in garnering consensus suggests that it should continue once the DTV Standard is adopted. Thus, in response to the Notice's query as to whether the DTV

[8/] See Appendix C of the Notice, which lists the 54 organizations that were members of the ATSC when it documented the DTV Standard.

Standard should be incorporated into the rules by reference or written into the rules word for word, we believe incorporation by reference is preferable.[9/] Such a method of adoption will facilitate the continuation of the inclusive inter-industry process whereby revisions to the DTV Standard may be worked out in the private sector. ATSC can then revise portions of the DTV Standard for the Commission's adoption, following the standard notice and comment process.

B. THE DTV STANDARD'S TECHNICAL VIRTUOSITY MAXIMIZES SPECTRUM EFFICIENCY, INTEROPERABILITY, AND GROWTH.

The Grand Alliance system, which the DTV Standard documents, was designed with several goals in mind. First, in compliance with FCC directives, it aimed to transmit HDTV within the existing broadcast spectrum, over standard bandwidth 6 MHz channels with minimum interference to NTSC transmissions. Second, throughout the process, the Grand Alliance sought to make DTV broadcasting interoperable with computer applications (supporting the adoption of square pixel and progressive scan formats) and asynchronous transfer mode ("ATM") applications. In seeking comment on its proposal to adopt the DTV Standard, the Notice recognizes the DTV Standard's success in satisfying these goals. Specifically, the Notice praises the DTV Standard for its flexibility in handling a broad range of functions today and its extensibility to functions yet to come. See Fifth NPRM, at 8. The Notice goes on to seek comment on whether the DTV Standard is sufficiently flexible, extensible, interoperable and internationally compatible. See id., at 14, 24, 27.

[9/] The two documents that should be incorporated by reference are: ATSC Doc. A/53, ATSC Digital Television Standard, 16 September 1995 and ATSC Doc. A/52, ATSC Digital Audio Compression Standard (AC-3), 20 December 1995.

In responding to the questions the Notice poses, it is important to frame these issues properly and to remember that the goal of this proceeding is to preserve and enhance the public's universally available, free, over-the-air television service. Consumer-friendly DTV policies also should seek to make different video technologies as compatible and interoperable as possible, but should not sacrifice the quality and viability of the public's free broadcast television service in order to satisfy the parochial interests of particular industries. The DTV Standard strikes the proper balance between enabling the roll-out of DTV and preserving technological flexibility and growth opportunities. Adoption of the DTV Standard will increase the likelihood that broadcast, cable, film, and computer industries, here and abroad, will develop compatible products and services for the public benefit.[10/]

The ACATS process emphasized interoperability from the start. With the help of the computer industry and others, it identified the technical factors that affect interoperability. These factors "were based on the needs and desires exhibited by alternative media advocates, not only for the delivery of terrestrial broadcast television programming, but also for other delivery approaches and applications relating to computing, telecommunications, motion pictures, and imaging."[11/] These factors were: (1) an all-digital implementation based on a layered architecture model; (2) the use

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[10/] The ATSC DTV Standard forms the basis for international agreement on digital terrestrial television broadcasting and has been incorporated into international draft standards. See Appendix A, attached hereto. Most recently, the ATSC digital video and audio specifications were selected as the basis for high quality video and audio by the Digital Audio Video Council ("DAVIC"), a non-profit association based in Geneva. The DAVIC membership includes more than 200 companies from more than 25 countries, representing all sectors of the audio-visual industries. The ATSC specifications will become a part of the DAVIC 1.2 standard.

[11/] ATV System Recommendation approved by the Advisory Committee in 1993, cited in letter of Richard E. Wiley, ACATS Chairman, to Rick Shriner, VP, Apple Interactive Media (July 10, 1995).

of universal headers and descriptors; (3) the ability to transmit the signal in progressive scan format; and (4) the use of a flexible, packet data transport structure. The DTV Standard satisfies each and every one of these goals. ACATS' recommendation that the Commission adopt the DTV Standard, as well as the many other endorsements the DTV Standard has received, demonstrates that the DTV Standard excels in the areas of interoperability and compatibility.[12/]

We address below the flexibility, extensibility, interoperability and international compatibility issues that the Notice raises, as appropriate, with respect to the picture, compression and transport layers of the Grand Alliance system.[13/]

1. Picture Layer.

(a) Scanning.

The agility of the ATSC DTV Standard is reflected in its inclusion of 18 (6 for HDTV and 12 for standard definition television) different scanning formats and frame rates in the layer of the signal that transmits the picture. The DTV Standard for HDTV consists of square pixel formats designed for ease of use with personal computers, motion pictures, and existing HDTV production equipment as well as ease of

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[12/] In May 1994, about 180 members of the "Advanced Digital Video in the NII" Workshop recommended rapid adoption of a transmission standard based on the Grand Alliance system. The Workshop was sponsored by the Clinton Administration's Technology Policy Working Group, the National Institute of Standards and Technology, the Electronic Industries Association, the Institute of Electrical and Electronic Engineers-USA, the Society of Motion Picture and Television Engineers, the Cross-Industry Working Team and ATSC. This recommendation was approved by the Information Infrastructure Task Force in January 1995. See Advanced Digital Video and the National Information Infrastructure, Report of the Information Infrastructure Task Force, Committee on Applications and Technology, Technology Policy Working Group (February 15, 1995). See generally Reply Comments of the Grand Alliance to the Fourth Notice of Proposed Rulemaking, MM Docket No. 87-268 (January 22, 1996) at 38-40 ("Grand Alliance Reply Comments").

[13/] We will address compatibility with other video media separately, below.

conversion to the NTSC standard. This versatility greatly expands the value of DTV to consumers while adding very little to the price of consumer equipment.

The Grand Alliance system supports six combinations of pixel formats and frame rates for HDTV. These combinations consist of: (1) two formats (1920 x 1080 pixels and 1280 X 720 pixels), each with a wide 16:9 aspect ratio, that are related to each other and to the 640 X 480 VGA computer format by a 3:2 ratio, and (2) three nominal frame rates (60, 30, and 24 Hz). Progressive scanning (presenting lines in succession from the top of the picture to the bottom, with a complete image sent in each frame) is used in every combination of picture format and frame rate, save for the one HDTV format of 1920 x 1080 at 60 Hz, which requires interlaced scanning (presenting odd and even numbered lines consecutively in two separate fields) for this picture resolution to fit in a 6 MHz channel.[14/] In addition, the ATSC DTV Standard proposes twelve standard definition television transmission formats, of which nine are progressive scan. Thus, 14 of the 18 DTV formats are progressive scan.

Whereas the DTV Standard is an open platform that would allow the market to select the scanning that is best for different types of programming, some in the computer industry reject this open standard and argue instead for a more rigid, inflexible standard that would eliminate the single interlaced HDTV format.[15/] The Notice itself effectively points out the deficiencies of this position and, citing the computer industry's

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[14/] De-interlacing devices have been built by several manufacturers to convert interlaced scan for progressive displays. See Grand Alliance Reply Comments, at 41 (interlaced transmissions may be displayed in progressive format without material degradation). Conversely, devices to convert progressive scanned information for display on interlaced displays also have been built.

[15/] See Fifth NPRM, at 18; See also Comments of Apple Computer to the Fourth NPRM (November 20, 1995), at 4; Comments of Microsoft Corporation to the Fourth NPRM (November 20, 1995), at 4-5.

ample opportunity to participate in the ACATS standard-setting process, places the burden of persuasion on those opposed to adoption of the DTV Standard. The Notice also indicates that concerns with display format and frame rates are best addressed not by the DTV Standard, but by receiver and computer manufacturers responding to the market. See Fifth NPRM, at 18-20. Once the Commission has ensured the minimal degree of uniformity necessary to justify consumer confidence in DTV, it should allow the market to select from among the various options the DTV Standard supports. Based on its own history, the computer industry knows better than most the effectiveness of the market in handling such a task.

Opponents to the DTV Standard's adoption have failed to offer any compelling reason to abandon the ATSC DTV Standard, much less met their burden of proof to justify narrowing the range of DTV transmission capabilities and consumer options. The key to understanding how the DTV Standard creates, rather than constricts, possibilities is that the DTV Standard establishes *transmission*, not *display*, protocols and that it does not mandate which particular transmission scanning format or frame rate must be used. Thus, the DTV Standard fulfills the computer industry's desire to use progressive scan for text and graphics in that five of its six scan formats are progressive. Even material that is *transmitted* using the lone interlaced HDTV format may be *displayed* in a progressive format.

Far from detracting from the DTV Standard, inclusion of the interlaced scan format in the DTV Standard actually adds value. Many broadcasters believe that interlaced technologies currently are superior for some non-film based applications. Where 1000 or more lines are required, interlaced scan would currently be the method of choice under the DTV Standard. When progressive technology is capable of

achieving this same line count -- ACATS supported the migration of the interlaced format to a progressive format.[16/] The inclusion of interlaced scan as an option accommodates the interests of the broadcasters who favor it for some applications while still accommodating the needs of others in both the broadcasting and computer and film industries that favor progressive technologies. In addition, including interlaced scan in addition to progressive scan will not add significantly to receiver prices.

(b) Aspect Ratio.

The use of an aspect ratio that is 16 units wide by 9 units tall makes the picture layer suitable for display of wide-screen television programming and motion pictures. The ATSC decided to advance the 16:9 aspect ratio after years of deliberations in which the motion picture and television production communities participated.[17/] The Grand Alliance and other system proponents then designed their systems to that display shape. The Notice requests comments on the claims of some cinematographers that a 2:1 ratio is necessary to better display one particular film genre. See Fifth NPRM, at 19. This flurry of dissatisfaction comes late in the process and reflects a disregard for the needs of the vast majority of television programming and the realities of set design. The 16:9 aspect ratio is by far the most appropriate display dimension for the following reasons:

First, it is the format selected by the Society of Motion Picture and Television Engineers ("SMPTE") as the format best designed to deliver a wide range of

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[16/] See Grand Alliance Reply Comments, at 40.

[17/] See Letter of Stanley Baron, President of the Society of Motion Picture and Television Engineers and head of the ATSC Technology Group on Distribution to Donald A. Norman, Advanced Technology Group of Apple Computer (August 28, 1995) ("Baron Letter") and Stanley Baron, *The ATV Standard: Understanding the Choices*; see also Fifth NPRM, at 19-20.

programming (all TV programming and the vast majority of films) in an appealing way to the human eye in the home environment. From an aesthetic perspective, the 16:9 (or 1.78:1) ratio best accommodates the many video formats that DTV will transmit because it accommodates the 4:3 NTSC aspect ratio that will continue to constitute a large portion of current and archival material while being quite close to the 2:1 aspect ratio that some cinematographers prefer.[18/]

A small segment of the motion picture industry has complained that the 16:9 aspect ratio will stunt the television presentation of the wide film formats of 2.4:1.[19/] Of all the feature films being made today, these unusually wide aspect films constitute only about 20%. In any case, the 16:9 ratio manages to accommodate even these films quite well. They will occupy 100% of the screen's width and 76% of the screen's height, which is far better than the appearance of such films on an NTSC 4:3 (or 1.33:1) screen. In addition, if a 2:1 aspect ratio screen were used, the total area of the picture would be only 5.3% larger. An even better parameter for judging the 16:9 aspect ratio is the 80% of films that have a 1.85:1 aspect ratio. These pictures will occupy 100% of the 16:9 screen's width and 96% of its height. On a 2:1 aspect ratio screen, their total picture area would be 9.9% smaller. Thus, while a 2:1 screen might

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[18/] See Baron Letter, at 5-6. In fact, the 16:9 screen is significantly better for film than for NTSC programming, while the 2:1 screen would be disastrous for NTSC programming. Mapping a 4:3 aspect ratio image onto a 16:9 display will require black bars on the left and right sides of the image, occupying 33% of the display area. Mapping the same image on a 2:1 display would require bars occupying 50% of the display. Mapping 1.85:1 and 2.35:1 images onto a 16:9 display would require black bars on the top and bottom of the image, occupying only 4% and 32% of the display respectively.

[19/] See, e.g., Letter of Gene Reynolds, President of the Directors Guild of America, Inc., to Chairman Hundt (May 2, 1996).

be marginally better for the 20% of very widest aspect films, it would be *worse* for the remaining 80% of film and all other 16:9 or 4:3 television programming.

Second, the 16:9 aspect ratio is the preferred format around the world. The 16:9 ratio has been adopted for HDTV at the global level by the International Telecommunication Union. Moreover, the EU has set its sights on developing "the market for advanced television services and products having the . . . wide-screen 16:9 aspect ratio."[20/] Japan too has endorsed the 16:9 ratio.[21/] This international approval improves the chances that programming produced in the U.S. will sell overseas and that programmers will be able to amortize the costs of producing expensive HDTV programs for a single display format. The international commitment to 16:9 is now so strong that there is little chance that alternative formats could gain sufficient market power to achieve these benefits; there is a significant chance that the per-viewer cost of programming could be too high to encourage new production. In addition, the fact that manufacturers are already equipped to build 16:9 picture tubes, production equipment, and cameras will make consumer equipment more affordable.

Third, the 16:9 ratio is the most economical for consumers. The cost to consumers of adopting a 2:1 aspect ratio would be very high. They would have to purchase far more expensive sets that were not ideally (or even appropriately) suited for most television programming. While a 2:1 set has a display area that is 12.5% greater than a 16:9 set (for the same picture height), its weight may be 30-50 percent higher to support the display device. Because memory and display are the most costly elements of

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[20/] Directive 95/47/EC of the European Parliament and of the Council on the Use of Standards for the Transmission of Television Signals (24 October 1995)

[21/] See Baron Letter, at 2.

a DTV set, the additional weight and memory necessary to sustain a 2:1 display would add considerably to the consumer's financial burden.[22/]

2. Compression Layer.

The compression layer transforms video and audio into a coded bit stream according to the MPEG-2 (International Standards Organization Moving Picture Experts Group) video data compression standard[23/] and the AC-3 audio data compression standard,[24/] respectively. Use of the MPEG-2 standard should render DTV output compatible with the increasingly popular MPEG-1 and MPEG-2 computer multimedia applications at the level of the compressed bit stream. In addition, use of MPEG-2 will render DTV compatible with the mass of international standards. There has been no significant opposition to the use of MPEG-2 as part of the DTV Standard, and the DTV Standard should be adopted in this respect as in all others.

3. Transport Layer.

The transport layer was designed to accomplish: (1) the flexible delivery of a diverse range of picture, sound, and data services, and (2) interoperability with computer applications. Both goals are accomplished by packing the video and audio bitstreams into fixed-size data packets, each containing a single type of data (e.g., video, audio, text) with packet headers. This modular design promotes interoperability,

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[22/] See Baron, *The ATV Standard: Understanding the Choices*, at 8. It should be noted that adopting an aspect ratio of 2:1 would reduce DTV and computer interoperability. For example, 2:1 is not one of the image aspect ratios defined (4:3 and 16:9 are included, however) in the Video Electronics Standards Association ("VESA") Extended Display Identification Data Standard ("EDID"). See EDID, Ver. 2 rev.0, April 19, 1996, VESA, p. 16.

[23/] ISO/IEC IS 13818-1, International Standard (1994), MPEG-2 Systems and ISO/IEC IS 13818-2, International Standard (1994), MPEG-2 Video.

[24/] ATSC A/52 Digital Audio Compression Standard (AC-3).

flexibility and extensibility. Additional interoperability comes by virtue of the fact that the packetized transport system harmonizes with the computer and telecommunications industries' ATM technologies. The Grand Alliance 188 byte MPEG-2 packet structure, consisting of 184 bytes of payload and 4 bytes of header.[25/] A method was developed, tested and validated to interoperate the MPEG-2 and ATM (48 byte payload with a five byte header) packets using a 4:1 ratio so that MPEG-2 can carry ATM data and ATM can carry MPEG-2 data. Because the Grand Alliance system creates a digital pipe filled with data packets, it can carry up to 19.3 Mbits/s per channel of any kind of digital information, scaled for any use (naturally, the bulk of this information generally will be related to the television program). This type of flexibility ensures extensibility as well. Later generations of receivers can be built to recognize newly created packet headers associated with new capabilities that earlier receivers will ignore.[26/] There has been no opposition to the use of this MPEG-2 compliant transport technology, and it should be adopted as part of the DTV Standard and by as many video distribution media as possible.

II. CONSUMER INTERESTS AND THE SUCCESS OF DTV REQUIRE ADOPTION OF THE ATSC DTV STANDARD.

A. THE UNIQUE CHARACTERISTICS OF TELEVISION BROADCASTING COMPEL ADOPTION OF A STANDARD.

Certainty that there will be a single standard, capable of improvement over time, is critical to the introduction of services like DTV, where value is derived

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[25/] The packet is compliant with the MPEG-2 Standard. Within the header area is the information required to combine multiple video, audio and other data streams into a single related program stream as well as the capability to provide conditional access. There are also optional provisions to carry private user messages.

[26/] See Comments of the Grand Alliance to the Fourth NPRM (November 15, 1995), at 2-3.

from the nationwide network of program producers, local transmitters and home receivers operating on compatible technologies.[27/]

Television broadcasting is a quintessential open "networked" product: consumers, broadcasters, and equipment manufacturers benefit from a common transmission standard that permits a mass audience to support and receive the product. Because the value to each television consumer increases with the size of the consumer base, network externalities that could limit the size of that base (such as conflicting transmission standards) have the potential to reduce radically the value of broadcast television to consumers and to stall the transition to DTV. Absent a mass market for a single transmission standard, the quality, variety, and availability of system components decrease; equipment costs rise; television production falls; and consumers suffer.[28/]

Even more than other networked technologies, the successful introduction of DTV will be unusually dependent on positive externalities (i.e., users conferring benefits on other users of a common technology) because the entity transmitting the product has no control over the entity receiving the product. Broadcast television's competitors like cable, DBS, and telcos can support technological improvements and optimize closed systems by charging their customers and exercising exclusive control over both ends of their transmission media. Broadcasters, on the contrary, cannot control the ability of their viewers to receive the transmissions and must take a leap of faith that their audience will follow their technological lead. In the absence of control,

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[27/] See Joseph Farrell, *et al.*, *Standard Setting in High Definition Television*, Brookings Papers on Economic Activity: Microeconomics, 1-93 (1992), at 26f.

[28/] See Bruce M. Owen and Steven S. Wildman, Video Economics (Harvard University Press 1992), at 265-267 and 287-291.

careful coordination between transmitter and receiver is necessary to make the DTV system work. The need for such coordination renders advertiser-supported television, which subsists on a mass nationwide audience, exceptionally vulnerable to the risks of a less-than-certain technology choice.[29/] The adoption of a single DTV transmission standard reduces these risks and is justified by the existence of externalities, as discussed herein.[30/]

Why is this degree of coordination necessary? The transition of free over-the-air television service from analog to digital will transpire in a peculiarly uncertain business environment. Broadcasters have every interest in making the transition to DTV as quickly as possible so that they can discontinue the administratively and financially burdensome operation of two signals. The public also has an interest in making the transition to DTV expeditiously so that the reallocation of broadcast spectrum can begin as soon as possible. Notwithstanding the strength of these incentives to progress swiftly through the transition, these incentives alone will not be sufficient if there is too much uncertainty in the market. The wide array of players critical to the success of DTV will not participate in the transition to DTV unless they are confident that there is a real opportunity for a *comprehensive* transition. Establishing a standard is the most important step to be taken toward securing the confidence of *producers* (who must develop appropriate programming), *equipment manufacturers* (who must produce new types of television sets and other equipment), *investors and financial institutions* (who must

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[29/] Public television, although not advertiser-supported, must also reach a mass nationwide audience to further well-established federal policy and to maintain economic viability.

[30/] See Owen, at 275

decide whether to support transition efforts), *broadcasters* (who must invest in the technology to transmit the signal), and *consumers* (who must make equipment choices).

Adoption of the DTV Standard will ameliorate the extreme uncertainty for many of these critical players. It will give stations the confidence to invest approximately $17 billion, most of it before any viewer has a DTV set, and all of it without any expectation that the audience base (or advertising base) will be any larger at the end of the transition than it is today. At least the choice of technology should not pose unreasonable business risks. The success of the transition depends on the ability of stations to reach the same audiences with DTV that they do with today's service and on their confidence that other broadcasters will be doing the same. Adoption of the DTV Standard will allow stations to count on their fellow broadcasters to move forward with compatible equipment and to predict the performance of neighboring stations' systems so as to plan for interference. Adoption of the DTV Standard also will provide a basis for confidence in the steady movement toward elimination of NTSC service.

In addition, adoption of the DTV Standard will secure the confidence of equipment manufacturers by permitting them to build to known specifications with the assurance that their goods will penetrate the mass market quickly. This equipment then will be able to compete on price, technical quality and features, not on which signals it receives.[31/] Consumers, furthermore, will be able to make purchasing decisions with the confidence that they will not be stranded with obsolete or only partially networked

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[31/] See, Joseph Farrell, *Competition, Comparability and Standards: The Economics of Horses, Penguins and Lemmings*, in H. Landis Gabel, Product Standardization and Competitive Strategy, 1-21, at 5 (1987).